

navigation between this point and Saint Louis was practically suspended after this date. There was floating ice in the river on the 27th, 28th, and 30th.

Ohio River.—Cairo, Ill.: reports from Metropolis, Ill., state that the heavy floating ice interrupted navigation on the 29th; on this date the packet running between Cairo and Paducah, Ky., was compelled to discontinue trips.

Louisville, Ky.: the river was covered with thin ice on the morning of the 29th, on which date navigation was suspended for all boats except the larger steamers.

Laconia, Harrison Co., Ind.: navigation was suspended on the 30th on account of low water and floating ice in the river.

Allegheny and Monongahela rivers.—Pittsburg, Pa.: floating ice in both rivers from the 23d to the 26th and 28th, and in the Monongahela on the 30th and 31st; the Allegheny froze over on the 31st.

HIGH TIDES.

Coney Island, N. Y.: this island was swept by a northeast gale on the 28th, and the hotels and other property near the beach were badly damaged by the high tide. The beach was strewn with large quantities of timber and debris.

Long Beach, N. J.: the strong southeasterly gale on the 28th caused a very high tide which damaged property to a great extent.

High tides also occurred as follows:

Duke, Fla., 1st.; Chicamcomico, N. C., 1st to 3d; Eastport, Me., 16th; Wilmington, N. C., 17th; Atlantic City, N. J., 18th.

LOW TIDE.

Staten Island, N. Y.: an unusually low tide occurred on the 29th. "Split Rock," in the bay of Tompkinsville, L. I., which had not been seen for several years, was exposed to view.

STAGE OF WATER IN RIVERS AND HARBORS.

In the following table are shown the danger-points at the various stations and the highest and lowest depths for December, with the dates of occurrence, and the monthly ranges:

Heights of rivers above low-water mark, December, 1887 (in feet and tenths).

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
Red River:						
Shreveport, La.....	29.9	24, 25	21.6	1	8.0	13.6
Arkansas River:						
Fort Smith, Ark....	22.0	4	8.8	30	1.1	7.7
Little Rock, Ark....	23.0	7	10.1	1	1.4	8.7
Missouri River:						
Omaha, Nebr.....	18.0	24, 25, 26	6.1	12, 13	2.1	4.0
Leavenworth, Kans.	20.0	5	4.1	15, 16	3.2	0.9
Mississippi River:						
Saint Paul, Minn....	14.5					
La Crosse, Wis.....	24.0					
Dubuque, Iowa.....	16.0	5, 6, 7	3.2	2	1.8	1.4
Keokuk, Iowa.....	14.0	21	1.7	3, 6	0.0	1.7
Saint Louis, Mo....	32.0	9	7.5	26, 27	0.8	6.7
Cairo, Ill.....	40.0	12, 13	8.0	31	2.0	6.0
Memphis, Tenn.....	34.0	14, 15, 16	6.0	1, 2, 31	2.6	3.4
Vicksburg, Miss....	41.0	20	5.0	2, 3	3.5	8.5
New Orleans, La....	13.0	23	2.8	1, 30	1.6	1.2
Ohio River:						
Pittsburg, Pa.....	22.0	7	6.9	30	3.8	3.1
Cincinnati, Ohio....	50.0	17	7.5	2, 3	4.3	3.2
Louisville, Ky.....	25.0	20	4.4	2, 3	3.2	1.2
Cumberland River:						
Nashville, Tenn....	40.0	27, 28	3.6	1, 2, 3	0.8	2.8
Tennessee River:						
Knoxville, Tenn....	.....	29	4.5	4	1.8	2.7
Chattanooga, Tenn.	33.0	30	5.5	2-6	1.6	3.9
Monongahela River:						
Pittsburg, Pa.....	29.0	7	6.9	30	3.8	3.1
Savannah River:						
Augusta, Ga.....	32.0	25	15.1	2-5	6.0	9.1
Sacramento River:						
Red Bluff, Cal.....	.....	29, 30	1.9	21-27	0.6	1.3
Sacramento, Cal....	.....	30	10.8	24-28	7.5	3.3
Willamette River:						
Portland, Oregon....	.....	9	10.6	24	1.6	9.0

* Frozen after 20th.

† River frozen entire month.

‡ Below bench-mark.

Nashville, Tenn.: the first steamer since the suspension of navigation on account of low water, came up the Cumberland River from the Ohio on the 10th, the depth of water shown by the Nashville gauge being two and eight-tenths feet on that date. Navigation on the lower Cumberland was resumed on the 26th, and on the upper Cumberland on the 29th.

ATMOSPHERIC ELECTRICITY.

AUORAS.

Auroras were observed during the month as follows: 6th, Cornish and Kent's Hill, Me.; North Truro, Mass.; Manitowoc, Wis. 7th and 8th, Manitowoc, Wis. 12th, Fort Totten, Fort Buford, and Webster, Dak.; Cornish, Me.; Cambridge, Mass.; Moorhead and Saint Vincent, Minn.; Poplar River, Mont. 13th, Webster, Dak.; Cornish, Eastport, and Kent's Hill, Me.; Poplar River, Mont.; Nashua, N. H.; Block Island, R. I. 14th, Egg Harbor City, N. J.; Manitowoc, Wis. 15th, Fort Buford, Dak. 16th, Bismarck, Dak.; Cornish and Kent's Hill, Me.; Moorhead and Saint Vincent, Minn.; Fort Custer and Poplar River, Mont.; Northfield, Vt. 17th, Fort Buford, Dak.; Cresco, Iowa; Duluth, Minn.; Poplar River, Mont.; Nashua, N. H. 18th, Saint Vincent, Minn. 20th, Wakefield, Kans. 21st, Webster, Dak.; Cornish, Eastport, and Kent's Hill, Me.; Blue Hill Observatory, Cambridge, and Fall River, Mass.; Moorhead and Saint Vincent, Minn.; Nashua, N. H.; Block Island, R. I.; Northfield, Vt. 22d, Blue Hill Observatory, Mass. 29th, Des Moines, Iowa.

THUNDER-STORMS.

Thunder-storms occurred as follows: Dodge City, Kans., 1st; Palestine, Tex., 3d; and Salt Lake City, Utah, 30th.

ELECTRICAL PHENOMENA.

Keeler, Cal.: on the evening of the 1st, during a light rain storm, and after the rain had ceased, the atmosphere was charged with electricity to an unusual degree, as was shown by the working of telegraph instruments. The office stove emitted electric sparks one-eighth of an inch in length.

Fort Sully, Dak.: on the 3d the telegraph wires were highly charged with atmospheric electricity; electric sparks one inch long were observed about the "cut-out" at 10 p. m.

Cheyenne, Wyo.: the presence of atmospheric electricity was very marked on the 12th; sparks one-eighth of an inch in length were produced by touching the steam heater, and all metallic surfaces or points when touched gave shocks which were quite perceptible.

MISCELLANEOUS PHENOMENA.

METEORS.

Dale Enterprise, Rockingham Co., Va.: a brilliant meteor was observed on the 11th, moving west; this vicinity was lighted up for several seconds as if by a prolonged flash of lightning.

Meteors were also observed as follows:

3d, Cleburne, Tex. 4th, Clayton, N. J. 5th, Little Rock,

Ark.; Biloxi, Miss.; Fort Stanton, N. Mex. 6th, Clayton and Egg Harbor City, N. J. 7th, Wilson, Kans.; Woodstock, Md.; Kalamazoo, Mich. 8th, Fort Buford, Dak. 9th, Savannah, Ga. 10th, Stateburg, S. C. 11th, Wilson and Yates Center, Kans.; East Portland, Oregon; Quakertown, Pa.; Stateburg, S. C.; University of Virginia, Va. 12th, Archer and Cedar Keys, Fla.; Lebo and Wilson, Kans.; Beverly, N. J.; Charlotte,

N. O.; Andersonville, S. C.; University of Virginia, Va. 13th, Quakertown, Pa. 14th, Vashon, Wash. 15th, Marquette, Nebr. 17th and 18th, Fort Sully, Dak. 19th, Nashua, N. H. 21st, Boise City, Idaho; Nashua, N. H.; Clayton, N. J. 23d, Fort Stanton, N. Mex.; Vashon, Wash. 24th, Andersonville, S. O.; Cairo, Ill. 25th, Dover, N. J.; Vashon, Wash., 26th, Yaquina L. H., Oregon. 27th, Dover, N. J. 28th, Beverly, N. J.

MIGRATION OF BIRDS.

Geese flying southward.—Linkville, Oregon, 2d, 3d; Red Bluff, Cal, 2d, 5th, 29th; Boston, Mass., 9th; Omaha, Nebr., 11th; Fort Madison, Iowa, 13th, 16th; Fort Sill, Ind. T., 14th; Fort Smith, Ark., and Keokuk, Iowa, 19th; De Soto, Nebr., 27th.

Geese flying westward.—San Antonio, Tex., 10th.

Swans flying eastward.—Nicolaus, Cal., 25th.

Ducks flying southward.—Corpus Christi, 20th; Savannah, Ga., 28th.

MIRAGE.

Fort Maginnis, Mont.: at 1.30 p. m. on the 6th buttes, woods, and basins situated about sixty miles southwest of station were

plainly seen and recognized; the Yellowstone River, about fifty miles distant, was clearly defined, and its course could be traced for miles; this mirage was considered the most unusual that has been seen here for years.

Mirages were also observed at Saint Vincent, Minn., on the 11th, and at Marquette, Nebr., on the 6th, 9th, 10th, 21st.

PRAIRIE FIRES.

Fort Sill, Ind. T.: prairie fires were observed to the north and east of station on the 3d.

SAND STORMS.

Yuma, Ariz.: a violent sand storm began about noon on the 13th and continued until the following day; a maximum wind-velocity of forty miles per hour was recorded at 10.30 p. m.

Sand storms also occurred as follows: Yuma, Ariz., 2d, 11th, 29th; Fort Mojave, Ariz., 12th, 13th, 21st, 28th; Fort Grant, Ariz., 21st.

SUN SPOTS.

Mr. H. D. Gowey, North Lewisburg, Champaign Co., Ohio, observed sun spots as follows: 5th, 6th, 13th, 14th, 16th, 21st, 23d, 25th, 26th.

VERIFICATIONS.

INDICATIONS FOR 33 HOURS IN ADVANCE.

The percentages of verifications of the tri-daily indications for December, 1887, as determined from comparison of succeeding telegraphic reports are given in the table below:

The predictions for all districts east of the Rocky Mountains for December, 1887, were made by 1st Lieutenant Robert Craig, 4th Artillery, U. S. Army, Acting Signal Officer and Assistant, except those for Minnesota and eastern Dakota, which were made at Saint Paul, Minn., by 1st Lieutenant Thomas M. Woodruff, 5th Infantry, U. S. Army, Acting Signal Officer, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps; the verifications for all districts were determined by Junior Prof. H. A. Hazen.

Percentages of indications verified, December, 1887.

States.		States.	
Maine.....	76.35	Kentucky.....	81.87
New Hampshire.....	74.30	Ohio.....	76.32
Vermont.....	72.45	West Virginia.....	75.97
Massachusetts.....	76.28	Indiana.....	76.90
Rhode Island.....	77.02	Illinois.....	79.71
Connecticut.....	78.42	Lower Michigan.....	78.11
Eastern New York.....	71.35	Upper Michigan.....	78.81
Western New York.....	73.45	Wisconsin.....	77.71
Eastern Pennsylvania.....	73.97	Minnesota.....	75.40
Western Pennsylvania.....	77.10	Iowa.....	80.45
New Jersey.....	73.52	Kansas.....	77.45
Delaware.....	74.45	Nebraska.....	73.12
Maryland.....	69.48	Missouri.....	74.68
District of Columbia.....	78.03	Colorado.....	75.32
Virginia.....	74.13	Eastern Dakota.....	70.45
North Carolina.....	77.29	Southern California.....	86.65
South Carolina.....	73.13	Northern California.....	74.55
Georgia.....	74.10	Oregon.....	70.57
Eastern Florida.....	70.83	Washington Territory.....	73.37
Western Florida.....	71.71	By elements:	
Alabama.....	77.77	Weather.....	75.46
Mississippi.....	77.16	Wind.....	79.25
Louisiana.....	70.39	Temperature.....	74.11
Eastern Texas.....	69.81		
Arkansas.....	72.81	General average.....	75.30
Tennessee.....	78.19		

* In determining the general average percentage and the percentages for the different elements, Minnesota, eastern Dakota, and Pacific coast states have not been included.

CAUTIONARY SIGNALS.

Of the total number of cautionary and storm signals ordered during December, 1887, it was practicable to determine the justification or failure of sixty-nine; justified, forty-nine, or 71.02 per cent. Of the above, thirty-five were ordered for cautionary signals; number justified, twenty-six, or 74.29 per cent. Thirty-four storm signals were ordered; justified, twenty-three,

or 67.65 per cent. Total number of direction signals ordered, eighty-three; justified, seventy-eight, or 93.98 per cent. Number of signals ordered for easterly winds, forty; justified, thirty-six, or 90.00 per cent. Number of signals ordered for westerly winds, forty-three; justified, forty-two, or 97.67 per cent. Number of storms without signals, eight. Number of signals ordered late, i. e., after the justifying velocity had begun, seven, or 10.14 per cent.

COLD-WAVE SIGNALS.

Total number of cold-wave signals ordered, three hundred and sixteen; justified, two hundred and forty-seven, or 78.16 per cent. Sixty-three cold-wave signals were ordered during the month by the Signal Service Officer at Saint Paul, Minn., of which, fifty-three, or 84.13 per cent., were justified.

LOCAL VERIFICATIONS.

The following is from the report of the "Michigan State Weather Service" for December, 1887:

Weather and temperature signals are now displayed in one hundred and forty-two towns in the state, and on the baggage-cars of twenty-six trains on eight principal railroads of the state.

The percentage of verification of weather signals for December is as follows (the verification is taken from reports of displaymen furnished this office monthly): temperature, 81.6 per cent.; weather, 83.9 per cent.; temperature and weather, 82.8 per cent.

The percentage of verification of weather predictions for December on the D., G. H., and M. R'y., is 85.0 for weather and 76.7 for temperature; on the C. & G. T. R'y., weather, 83.8, and temperature, 79.2; P. H. & N. W. R'y., weather, 82.0, and temperature, 83.2; M. C. R'y., for weather, 85.9, and for temperature, 92.8; G. R. & I. R'y., weather, 83.0, and temperature, 81.3; C. & W. M. R'y., weather, 85.8, and temperature, 84.7; P. O. & P. A. R'y., weather, 79.7, and temperature, 83.7.

Cold-wave signals were ordered by the Chief Signal Officer on the 4th at 11 a. m.; 10th, at 7 a. m., and continued until the 12th; on the 19th and continued until 7 a. m. 22d, and on the 27th and continued until 7 a. m. of the 29th. The signal of the 4th was verified by a fall of 30°; that of the 10th by 15°. The order of the 19th was not justified until the morning of the 22d, when a fall of 85° was recorded; a fall of 25° followed the order of the 27th.

The following is from the December, 1887, report of the "South Carolina Weather Service:—"

The percentage of verification of the weather and temperature predictions for the whole state was: for weather, 86.4; for temperature, 91.9.

The following is from the "Tennessee State Board of Health Bulletin" for December, 1887:

There were four cold-wave warnings received during the month, viz.: 4th-5th, 11th-18th, 19th-22d, and 27th-29th; all fully verified.

The percentage of verification of weather and temperature predictions, fur-